Exemption No. 7120A

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of

Bombardier Aerospace

For an exemption from § 25.785(b) of
Title 14, Code of Federal Aviation Regulations

Regulatory Docket No. 29820

PARTIAL GRANT OF EXEMPTION

By letter dated September 1, 2000, Michael B. Eddy, Vice President, Bombardier Business Aircraft Services, P.O. Box 11186, Tucson, Arizona 85734-1186, petitioned for an amendment of Exemption 7120, previously issued on January 31, 2000. That exemption had granted Bombardier certain relief from the general occupant protection requirements of Title 14 Code of Federal Regulations (14 CFR) § 25.785(b) for occupants of multiple place side-facing seats on BD700-1A10 Global Express airplanes during takeoff and landing. The petitioner now requests that the FAA revise the original Exemption 7120 to take into account the divan certification criteria recognized by Transport Canada for the side-facing divans installed on aircraft operated under Canadian register. Without these criteria, the divan certification requirements included in FAA Exemption 7120 do not match those currently accepted by Transport Canada. Therefore, the petitioner requests a revision to Exemption 7120 in an effort to "harmonize" the divan certification requirements between the two countries.

The petitioner requests relief from the following regulation:

> Section 25.785(b), Amendment 25-64, requirements for general occupant protection for occupants of multiple place side-facing seats that are occupied during takeoff and landing.

The petitioner provides the following supportive information:

"In mid July 1999, Bombardier Aerospace requested an exemption to § 25.785(b), Title 14 Code of Federal Regulations (14 CFR), through the New York Aircraft Certification Office (ACO). They simultaneously requested an exemption to AWM 525.785(b) in Canada. A Canadian Issue Paper 99-02 was opened, which included proposed side-facing divan certification criteria from Bombardier Aerospace. These criteria were modified from the FAA's generic criteria included in the Nov. 12, 1997 Draft Issue Paper CI-1 for side-facing divans. The Bombardier criteria used the FAA generic criteria to develop a certification approach that was tailored to the specific divans being developed by B/E Aerospace – AMP (B/E-AMP) for the Global Express. These criteria were refined by discussions with the FAA's Jeff Gardlin, Van Gowdy, and Steve Soltis. Finally, the actual FAA petition for exemption letter was sent by Mr. Rousseau on behalf of Bombardier Completion Center, Inc., but it unfortunately did not include the refined divan certification criteria.

"Certification Methodology

"The FAA's November 19, 1997 Memorandum identified the Draft Issue Paper for side-facing divans as 'guidance material' to be 'used to develop project-specific issue papers.' The BD700-1A10 Global Express is a fully compliant aircraft that is required to meet these criteria or an alternate set of criteria that is tailored to the specific divan products. It is understood that these alternate criteria must be consistent with the current state-of-the-art to be recognized. Bombardier has solicited the services of Oleson Technologies, Inc. (OTI), to assist in creating these criteria, based on OTI's unique experience with side-facing divan certification.

"The FAA's Draft Issue Paper identifies a testing approach that considers the multi-place divan to have at least three occupant seating positions. This is supported by the requirement to place a SID ATD in the 'center seat.' The current B/E-AMP divan design creates a 3-place divan installation by installing a 1-place divan and a 2-place divan adjacent to one another. Each divan is structurally tested as a stand-alone unit. By using this design methodology, any combination of divans can be installed to make longer divan installations. With the largest divan seating two occupants, a center seating position does not exist.

"Once the divans are structurally tested in free space using Hybrid II ATD's, an additional test is conducted to establish an Occupant Movement Envelope (OME). The OME is effectively an occupant body trajectory past the forward edge of the divan. This 16g test is conducted with no floor deformation and no yaw to produce the maximum body movement to be recorded. The OME is then increased to account for a range of occupant sizes. This test is conducted without interior components (end closures) installed forward of the side-facing divan. The OME establishes a 'stay-out zone' into which installation of interior components is prohibited. The zone established by the OME provides occupant protection through no interaction with interior components. For the 2-place divans, body-to-body contact is assessed during

the stand-alone testing at a fixed occupant spacing dictated by the divan length. Note that the 1-place divan is half the size of the 2-place divan such that the adjacent installation of two 1-place divans produces the same occupant spacing as the two-place divan.

"Occupant-to-occupant interaction and occupant interaction with interior components is also addressed by the Bombardier certification approach. If an interior component is installed within the OME, occupant interaction is predicted. Depending on the predicted contact, the appropriate occupant protection criteria are evaluated. For instance, if an armrest is installed adjacent to the forward edge of the divan that predicts torso contact, then lateral pelvic acceleration, TTI, harness loading, and body-to-body contact are assessed. This testing is conducted with a test dummy capable of recording the required data and not limited to just the SID ATD. This installation and occupant injury assessment testing is conducted with no floor deformation and with a yaw direction selected to predict critical contact with the component being evaluated. The test is not considered a structural test and the interior components being evaluated are not attached to the divan. This makes the interior components static components that are not subject to the strength requirements of § 25.562.

"The FAA Draft Issue Paper requires that all divans have 'end closures,' which are armrests, partitions, etc. Because this FAA requirement effectively introduces an occupant injury potential within the OME, Bombardier has relieved this requirement. In addition, a 2-inch padding requirement exists for interior components that predict occupant contact. Because the Bombardier criteria requires substantiation of the component by test (or rational based on a previous test), the actual or conservative stiffness of the component must be used for testing. Therefore, the padding may not be required to satisfy the injury protection criteria. Padding is then left up to the installer to provide an additional level of protection based on the interior component design. Finally, the FAA requirement to have the SID ATD in the center seat has been removed. Having a SID in the center seat will only evaluate contact to the torso of the SID. Because the critical body-to-body contact assessment prohibits significant occupant contact, the test would be considered a failure due to this contact and there would be no reason to use a SID to assess the contact.

<u>"Proposed Divan Criteria (Currently Recognized in Canada with Modifications for FAA):</u>

"1. Side-facing divans must meet the provisions of 14 CFR 25.562, Amendment 25-64.

"2. <u>Occupant Retention</u>: Acceptable occupant restraint must be verified during dynamic testing. The forward seated occupant's pelvis must be restrained within the longitudinal seating position length of the divan (must not move past the end of the divan structure at full load).

"3. Body-to-Body Contact: Critical contact between the head, shoulder, torso, and/or pelvis of one ATD on an adjacent seated ATD is prohibited during tests conducted in accordance with 14 CFR 25.562(b)(1) and (b)(2). Incidental contact of the feet, legs, arms, and/or hands that will not result in incapacitation of the occupants is acceptable. Contact during rebound is acceptable.

"4. Occupant Movement Envelope (OME): For the forward most seated occupant of the divan installation, an OME is established that accounts for a range of occupant sizes. The OME identifies the range of movement of the ATD's head, shoulder, torso, and pelvis. The OME is referenced to a structural point on the divan, which can be referenced to the aircraft. The OME establishes an occupant protection zone into which no interior components may be installed in order to meet the occupant protection requirements of 2., 3., 5., and 6.

"5. Thoracic Trauma Index (TTI): Unless it can be verified by 16g dynamic testing that no occupant contact occurs between occupants and interior components, TTI for the affected occupants must be substantiated by test or rational based on previous tests. When conducting an actual test to obtain a TTI value, an appropriate test device capable of registering such a value must be used. TTI must be less than 85g as defined in 49 CFR Part 572, Subpart F. The signal data must be processed in accordance with the specific test device used.

"6. Lateral Pelvic Acceleration (LPA): Unless it can be verified by 16g dynamic testing that no contact occurs between occupants and interior components, LPA for the affected occupants must be substantiated by test or rational based on previous tests. When conducting an actual test to obtain a LPA value, an appropriate test device capable of registering such a value must be used. LPA must be less than 130g.

"7. Shoulder Strap Loads: Where upper torso straps (shoulder straps) are used for divan occupants, tension loads in individual straps must not exceed 1750 pounds. If dual straps are used for restraining the upper torso, the total strap tension load must not exceed 2000 pounds.

"8. Certification Tests: As a minimum, the following structural tests are required for each divan.

- One 14g vertical test in accordance with 14 CFR 25.562(b)(1) with Hybrid II ATDs in all seat positions.
- One 16g longitudinal test in accordance with 14 CFR 25.562(b)(2) with Hybrid II ATDs in all seat positions, floor deformation, 10 degrees yaw, and with no interior components present unless attached to the divan.

"OME Tests:

- One 16g test for each divan type with Hybrid II ATD(s), no floor deformation, no yaw, and with no interior components present. The forward most occupant's head, shoulder torso, and pelvis excursion must be documented and increased to account for a range of occupant sizes.

"Occupant Protection Assessment Tests:

- For each installation that predicts occupant contact with interior components, a 16g longitudinal test is required using a side-impact ATD in the forward most position, Hybrid II ATD(s) in the other position(s), no floor deformation, and a yaw angle selected to predict critical contact with the component being evaluated. A body-to-body contact assessment must be made during this test by using at least one Hybrid II ATD installed adjacent to the rear of the forward most side-impact ATD. Hence, the entire divan installation need not be tested if the occupant centerline spacing is equal for all seating positions included in the entire divan installation.

"9. Installation Requirement:

- A means must be provided to retain the aft most ATD of the divan installation on the divan. This means may take the form of an interior component such as an armrest, cabinet, partition, bulkhead, etc. The presence of this type of structure (as verified by the actual aircraft installation) is adequate to show compliance with this requirement.

"It is also respectfully requested from the FAA that the comment period be waived, as no comments were received when a summary of the exemption was published in the Federal Register on December 6, 1999 (64 FR 68193). It is also requested to change the petitioner's name from Bombardier Completion Centre, Inc. to Bombardier Aerospace.

"The criteria proposed separates the structural verification testing from the occupant protection assessment testing. This provides a tool to assess various interior arrangements sought by executive customers. It is believed that a revision to Exemption No. 7120 will introduce a divan certification approach that is consistent with the current state-of-the-art and will meet the intent of the generic guidance provided to the industry by the FAA."

The FAA's finding concerning notice and public comment is as follows:

The FAA finds, for good cause, that action on this petition should not be delayed by publication and comment procedures for the following reasons:

1. A grant of exemption would not set a precedent because it is merely a technical revision to an existing exemption that does not alter the scope or effect of the existing exemption.

2. Delay in processing the exemption could have an adverse effect on the petitioner and its customers.

The FAA's analysis and summary of this petition is as follows:

The applicant's original petition for exemption from § 25.785(b) was based on FAA Memorandum, "Side-Facing Seats on Transport Category Airplanes," dated November 19, 1997. That memorandum provides dynamic test condition requirements and pass/fail criteria for side-facing seats on transport category airplanes. It reflected the FAA's best statement of criteria necessary for certification of side-facing seats at that time.

Contrary to the petitioner's perception, however, the FAA did not intend to *define* a multi-place divan as one having "at least three occupants." The reference in the memorandum to a "center seat" was made to ensure that that condition was addressed, if it existed. In any case, the FAA considers that "more than one occupant" constitutes a multi-place divan, regardless of whether the divan is made up of more than one individual seat assembly.

The FAA Memorandum, "Side-Facing Seats on Transport Category Airplanes," dated November 19, 1997, provides:

- The dynamic test conditions criteria. In terms of both pulse severity and types of tests currently required, these criteria are also considered directly applicable to side-facing seats. While it is true that the FAA wrote the regulation with forward- and aft-facing seats in mind, the orientation of the seat does not change the relevant test conditions.

- The pass/fail criteria. For these criteria, however, the orientation of the seat may be significant. Injury criteria currently are limited to head, spine, and femur loads. Head impact is evaluated for contact experienced by the head against any aircraft interior installations, and the pass/fail criterion is based on the resultant head acceleration, considering all axes of head motion. The lumbar spinal load is an axially compressive load that is primarily evaluated during the 14g, 60-degree test. The femur load is also compressive, and actually has not proved to be critical thus far. For a side-facing seat, other injury parameters may predominate such that evaluation of those parameters may be necessary to provide an acceptable level of safety.

In the original grant of exemption, the criteria given in the memorandum were followed quite closely, although not verbatim. In the requested revision to the exemption, the petitioner has asked for the following changes:

1. "End closures" not be mandated.

2. Padding on interior structure not be mandated.

3. A test with a dedicated "Side Impact Dummy (SID)" not be required.

4. The petitioner be designated as Bombardier Aerospace, rather than Bombardier Completion Center, Inc.

As noted in the original Exemption 7120, the FAA has attempted to define reasonable criteria for certification of multiple occupancy side facing seats, with the objective of establishing an equivalent level of safety. At present, and at the time the FAA issued the Memorandum referred to above, criteria sufficient to provide an equivalent level of safety have not been identified. Conversely, certain criteria as specified in the memo subsequently have been shown not to be necessary, or to provide little value.

With respect to the petitioner's specific requests for revision of the existing exemption, the FAA offers the following:

1. Regarding end closures, Exemption 7120 requires:

   > "All side-facing seats require end closures or other means *[emphasis added]* to prevent the occupant from translating off of the seat."

   The FAA considers that use of the restraint system for this purpose is another means to achieve the same objective. Therefore, the current exemption provides the relief sought by this amendment. It should be noted, and the petition addresses this point, that occupant retention is required for all occupants, including the aft-most occupant relative to the rear of the seat. Regarding installation of interior components forward of the seat, the FAA notes that the petitioner has characterized some components as part of the seat (end closures) and other components as not part of the seat, and therefore not subject to the dynamic test requirements. To clarify this, the FAA has determined that, to the extent that any interior component is installed either to provide occupant protection or retention, or to provide structural relief for the seat, that component must satisfy the dynamic test requirements. To the extent that such items do not contribute (e.g., introduce an injury mechanism) to compliance with the dynamic test requirements, they can be addressed as described by the petitioner.

2. The FAA originally required 2 inches of padding on the surface of structure that the an occupant could contact, in order to provide an unquantified, but nonetheless tangible, measure of energy absorption/injury protection. However, as noted by the petitioner, the requirements as they currently exist require measurement of several injury parameters, which, if satisfied without padding, should provide an acceptable level of safety. Therefore, the FAA considers that padding is not a specific requirement, if all the relevant injury criteria can be met. The FAA still encourages the use of padding where practical, however.

3. The FAA agrees that use of the SID may not be required, but a test dummy suitable for measuring Thoracic Trauma Index and lateral pelvic acceleration is required when those measurements are required. There are other such test devices that would require acceptance of the appropriate FAA Aircraft Certification Office if they were to be used for testing. Regarding use of the SID in the middle seat position, this is not part of Exemption 7120, so no further relief is required by this revision to the exemption.

4. Finally, the FAA has changed the name of the petitioner to Bombardier Aerospace, as requested.

For reasons of clarity, the FAA has restated, below, all the limitations for this exemption, rather than only those that are being amended in this revision.

The FAA may refine the compliance criteria for multiple occupancy side-facing seating to establish an equivalent level of safety. This may include additional injury criteria related to neck loads or other injury mechanisms. The guidance will be updated accordingly, and the certification of multiple occupancy seating may be processed via special conditions rather than exemptions. For this reason, the FAA does not agree with the petitioner's request for exemption for all Bombardier Global Model BD-7001A10 airplanes. The FAA will grant an exemption that will cover only airplanes that are manufactured for a specific amount of time. During this time, the FAA may refine the compliance criteria for multiple occupancy side-facing seating.

For the purposes of this exemption, the "date of manufacture" is the date on which inspection records show that an airplane is in a condition for safe flight. This is not necessarily the date on which the airplane is in conformity with the approved type design, or the date on which a certificate of airworthiness is issued. It could be earlier, but would be no later, than the date on which the first flight of the airplane occurs.

It should also be noted that the criteria set forth in this exemption, as well as in the original Exemption 7120, are intended to apply to airplanes that are operated in private use -- that is, airplanes that are not used for common carriage or revenue passenger service. The FAA has previously used the term "for hire" to address the latter aspect of the limitation. This has been the subject of some confusion, since certain provisions in the operating rules allow airplanes to be "for hire," but not to carry passengers for

revenue. The intent of this provision is not to prevent an owner from leasing an airplane to another user; however, it would prevent the airplane from being used either to carry passengers for hire, or to provide transportation to the general public, whether or not a fare was collected. The FAA does not anticipate that this provision will affect use of the airplane under its intended modes of operation.

The FAA's determination on this petition is as follows:

In consideration of the foregoing, I find that a grant of exemption is in the public interest and will not affect the level of safety provided by the regulations. Therefore, pursuant to the authority contained in § 49 U.S.C. §§ 40113 and 44701, delegated to me by the Administrator (14 CFR 11.53), Bombardier Aerospace is hereby granted an exemption from the requirements of § 25.785(b), for the general occupant protection requirements for occupants of multiple place side-facing seats that are occupied during takeoff and landing for Bombardier Global Model BD-7001A10 airplanes manufactured prior to January 1, 2004.

The following limitations apply to this exemption:

1. The airplane is not offered for common carriage, or operated in revenue passenger service.

2. Existing Criteria: All injury protection criteria of § 25.562(c)(1) through (c)(6) apply to the occupants of side-facing seating. The HIC assessments are only required for head contact with the seat and/or adjacent structures.

3. Body-to-Body Contact: Contact between the head, pelvis, or shoulder area of one Anthropomorphic Test Dummy (ATD) with the adjacent seated ATD's is not allowed during the test conducted in accordance with § 25.562(b)(1) and (b)(2). Incidental contact of the legs, feet, arms, and hands that will not result in incapacitation of the occupants is acceptable. Any contact between adjacent ATD's is acceptable during rebound.

4. Body-to-Wall/Furnishing Contact: If the seat is installed aft of a structure, such as an interior wall or furnishing, that would contact the pelvis, upper arm, chest, or head of an occupant seated next to the structure, then a conservative representation of the structure and its stiffness must be included in the tests. In most cases, the representation of the structure would be more rigid and have less deflection under load than the actual installation on the airplanes.

5. Thoracic Trauma: Thoracic Trauma Index (TTI) injury criteria must be less than 85, as defined in 49 CFR part 572, subpart F. Thoracic trauma index data must be processed as defined in Federal Motor Vehicle Safety Standard (FMVSS), part 571.214, section S6.13.5.

6. Pelvis: Pelvic lateral acceleration must not exceed 130g. Pelvic acceleration data must be processed as defined in FMVSS, part 571.214, section S6.13.5.

7. Shoulder Strap Loads: Where upper torso straps (shoulder straps) are used for sofa occupants, the tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

8. Seat Positions: All seat positions need to be occupied by ATD's for the longitudinal tests.

9. Occupant Retention: All side-facing seats require end closures or other means to prevent the occupant from translating off of the seat.

10. Longitudinal Tests: For the longitudinal tests conducted in accordance with the conditions specified in § 25.562(b)(2), a minimum number of tests will be required as follows:

    a. One test will be required with ATD's in all positions, with undeformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). For configurations with a wall or bulkhead immediately forward of the forward seat position on the sofa, a SID (or other suitable) ATD will be used in the forward seat position and a Hybrid II ATD(s) or equivalent will be used for all other seat locations. For configurations without a wall or bulkhead immediately forward of the forward seat, Hybrid II ATD's or equivalent will be used in all seat locations.

    b. One test will be required with Hybrid II ATD's, or equivalent, in all positions, with deformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). This could be considered the structural test, as well.

11. Vertical Test: For the vertical test, conducted in accordance with the conditions specified in § 25.562(b)(1), Hybrid II ATD's or equivalent will be used in all seat positions.

Issued in Renton Washington, on November 17, 2000.

(original signed by)
Donald L. Riggin, Acting Manager
Transport Airplane Directorate
Aircraft Certification Service